SECTION 02221 - TRENCH EXCAVATION AND BACKFILL FOR PIPELINES & APPURTENANT STRUCTURES

1.1 DESCRIPTION

This section covers excavation, trenching and backfilling for pipelines and appurtenances, complete. This item shall consist of all necessary clearing, grubbing and site preparation; removal of all material of whatever description that may be encountered; removal and disposal of debris; handling and storage of materials to be used for fill and backfill; all necessary bracing, shoring and protection; pumping and dewatering as necessary; all backfill, preparation of subgrades; and final grading, dressing and cleanup of the site.

1.2 STRIPPING

When crossing existing or prospective cultivated areas, gravel streets or other developed surfaces, the Contractor shall strip the cover material to full depth at the existing surfacing. This surfacing shall be stockpiled and placed back over the trench after backfilling to the extent that it is acceptable and usable for that purpose. Topsoil shall be removed to full depth of the topsoil, or to a maximum depth of 300mm (12 inches), whichever is less.

All established lawn areas cut by the trench or damaged during the course of the work shall be resodded to the complete satisfaction of the property owner.

1.3 TRENCH EXCAVATION

A. General. All excavation, trenching and shoring, and the like, under this contract shall be performed in a manner that meets with the OSHA Department of Labor, Safety and Health Regulations for Construction.

The Contractor shall excavate as necessary at the locations shown on the drawings, staked in the field or otherwise specified for the installation of pipelines. Excavations shall be made at each location by one of the two methods specified herein - either Type 1 or Type 2 trench excavation. Type 1 trench excavation will be used in most areas. Type 2 will be used when space limitations or other conditions dictate and as shown on the plans.

Whether trench excavation is by Type 1 or Type 2, the Contractor shall take precautions and protect all adjoining private and public property and facilities, including underground and overhead utilities, curbs, sidewalks, driveways, structures, and fences. Any disturbed or damaged facilities will be suitably restored or replaced at no cost to the Owner.

Crossing under sidewalks or curbs may be made by tunneling. If the Contractor elects to remove a portion of the sidewalk or curb, he must use a concrete saw for making neat joints, compact the backfill as specified, and pour a new concrete sidewalk or curb section.

During excavation, materials suitable for backfilling shall be piled in an orderly manner a sufficient distance from the banks of the trench to avoid overloading and to prevent slides or cave-ins. Excavated materials shall be piled on one side of the trench only, to permit ready access to existing fire alarm boxes, fire hydrants, valves, manholes and other appurtenances. Surface drainage of adjoining areas shall be unobstructed.

All excavated materials not required or suitable for backfill shall be removed from the site and wasted as directed by the Engineer.

Grading shall be done as may be necessary to prevent surface water from flowing into excavations, and any other water accumulating therein shall be promptly removed. Under no circumstances shall water be permitted to rise in unbackfilled trenches until after the pipe has been placed, tested and covered with backfill. Any pipe having its alignment or grade changed as a result of a flooded trench shall be relaid at no additional cost to the Government.

The bottom of the trenches shall be accurately graded to the line and grade shown on the drawings. Bedding material shall provide uniform bearing and support for each section of the pipe at every point along its entire length. Bell holes and depressions for joints shall be dug after the trench bedding has been graded, and shall be only of such length, depth and width as required for properly making the particular type joint. Unauthorized overdepths shall be backfilled with bedding material at the Contractor's expense.

B. Type 1 Trench Excavation. Excavation performed as Type 1 will not be shored or sheathed. The sides of all trenches greater than 1500mm (5 feet) in depth shall be sloped back to the angle of repose to preclude collapse, in accordance with Table P-1, Section 1926.652 of OSHA Safety and Health Regulations for Construction.

C. Type 2 Trench Excavation. Excavation performed and paid for as Type 2 shall be adequately shored and sheathed in accordance with the minimum requirements of OSHA Regulations, and as shown on Table P-2, Section 1926.652.

Portable trench boxes or sliding trench shields may be used for performing Type 2 excavation in lieu of a shoring system provided they are designed, constructed, and maintained in a manner which will provide protection equal to or greater than the sheathing or shoring required for the trench.

D. Trench Dimensions. Trench dimensions shall be as specified below.

1. Width. The width of the trench shall be such to provide adequate working room for men to install and join the pipe in the specified manner. The width of that portion of the trench (a) from the existing ground surface to the bottom of the trench for Type 2 Trench Excavation or, (b) from the bottom of the trench to a maximum of 1500mm (5 feet) above the bottom of the trench for Type 1 Trench Excavation, shall be as follows:

   a. A minimum of 1050mm (3'-6") for pipe sizes 300mm (12 inches) and under.

   b. A minimum of 600mm (2'-0') plus the outside diameter for pipe sizes greater than 300mm (12 inches) or a greater minimum width as specified by the pipe manufacturer.

   c. A maximum width as specified in the Special Provisions.

2. Depth of Trench. Trench depth shall be as required for the invert grade or pipe bury shown on the plans or specified elsewhere, plus an additional 100mm (4 inches) for Type 1 Pipe Bedding. Care shall be taken not to excavate below the required depth. If ledge rock, boulders or large stones are encountered at the bottom of the trench, excavating shall be carried a minimum of 150mm (6 inches) below the bottom of the pipe for backfilling with Type 1 Pipe Bedding.

   When soft or unstable material is encountered at the subgrade which will not uniformly support the pipe, such material shall be excavated to an additional depth as directed by the Engineer and backfilled with Type 2 Pipe Bedding.

E. Equipment. The use of trench digging machinery will be permitted except in places where its operation will cause damage to existing structures or features, in which case hand methods shall be employed.

Any equipment operating on tracks, which is to be used on pavement, shall be equipped with suitable pads to prevent damage to the pavement. All pavement damaged during construction by the Contractor's equipment shall be restored to its original condition by the Contractor.

F. Dewatering. Where ground water is encountered in excavation, it shall be removed to prevent unstable trench conditions, laying of pipe in water, water

entering the installed pipe, or any other interference with pipe laying and other construction operations.

G. Shoring, Sheeting and Bracing. The Contractor shall do all shoring, bracing and tight sheeting required to prevent caving and to protect his workmen, in accordance with Occupational Safety and Health Regulation Requirements, and to protect adjacent property and structures.

H. Excavation and Appurtenances. Excavations for manholes, hydrants, structures and other appurtenances shall be sufficient to allow for adequate compaction on all sides. The depth, provisions for removing water, and other applicable portions of these specifications shall apply to excavation for appurtenances.

1.4 TRENCH BACKFILL

A. General. All trenches shall be backfilled immediately after grade, alignment and jointing of the pipe has been inspected and approved by the Contracting Officer's Representative. Leakage tests, pressure tests or tests for alignment and grade shall be performed after backfill. If any test fails, the Contractor shall be responsible for work required to correct the defects at no additional cost to the Government.

B. Pipe Bedding Material.

1. Type 1 Pipe Bedding. Type 1 pipe bedding shall consist of the 100mm (4 inches) of bedding material under the pipe and the bedding material around and over the pipe to a point 150mm (6 inches) above the top of the pipe. The 100mm (4 inches) of bedding material under the pipe and up to the spring line of the pipe shall generally be described as consisting of sand, sandy gravel, or fine gravel having a maximum size of 19mm (3/4 inches) and having a maximum plasticity index of 6 as determined by AASHTO Methods T89 and T90.

Bedding material from the springline to 150mm (6 inches) over the pipe shall consist of select earth, sand or fine gravel, free from clods, lumps of frozen material, or stones larger than 40mm (1-1/2 inches) in their maximum dimensions. Where wet or otherwise unstable conditions exist, the material in this zone shall be free draining and nonplastic. Where suitable material is available in the material excavated from the trench, the Contractor may procure the select material by screening, sifting or manually sorting the material removed from the trench, as approved by the Contracting Officer's Representative.

To prevent migration of material from around the pipe, sand, sandy gravel or a material composed mainly of sand shall not be used for bedding material in the pipe zone where ground water is or will be present or where existing material contains voids which would allow migration. If these conditions are present, all bedding material shall be well graded. If ground water is encountered, well graded gravel will be placed at the direction of the Contracting Officer's Representative.

Bedding material under and around the pipe to 150mm (6 inches) above the top of the pipe shall be placed by hand or other careful manner so as not to damage or disturb pipe, in maximum layers of 150mm (6 inches) and thoroughly compacted by tamping. Special care shall be taken to assure complete compaction under the haunches of the pipe. Backfill material shall be placed in the trench for its full width on each side simultaneously.

Water settling of this portion of the trench will not be allowed. The addition of water shall be limited to that required for optimum moisture for maximum compaction of the material.

2. Type 2 Pipe Bedding. Type 2 pipe bedding shall be used as directed by the Contracting Officer's Representative to replace soft, spongy or other unsuitable material encountered in the trench bottom, and shall extend from the bottom of the Type 1 bedding material to the depth necessary to support the pipe. The Type 2 bedding material shall consist of suitable granular material meeting the following gradation, and shall have a maximum plasticity index of 6.

Sieve Opening	% Passing
75mm (3-inch)	100
Number 4	0 - 25
Number 8	0 - 10

C. Trench Backfill.

1. General. After the select pipe bedding material has been placed and compacted as specified above, the remainder of the trench backfilling shall be done. All backfill material shall be free from cinders, ashes, refuse, organic and frozen material, boulders, or other materials that are unsuitable. From 300mm (one foot) above the top of pipe to 150mm (6 inches) below the ground surface, or to the subgrade elevation for streets or paved surfaces, material containing stones up to 200mm (8 inches) in the greatest dimension may be used. A minimum of 450mm (18 inches) of

compacted material is to be placed over the pipe, before any heavy pieces off compaction equipment are allowed to be placed in the trench.

Material shall be placed in layers so that, after compaction, the maximum layer thickness shall be 200mm (8 inches). Thicker layers may be allowed if the Contractor can satisfactorily demonstrate to the Contracting Officer's Representative, through the use of a test strip or section, that his methods and equipment are capable off achieving the specified density.

Trench backfill from the top of the pipe bedding material to ground surface or to the subgrade of street surfacing is separated into three classifications. Type A Trench Backfill refers to compacted backfill in streets or paved areas. Type B Trench Backfill is designated for alleys, fields, borrow pits, unimproved streets or other unsurfaced areas where a lesser degree of compaction of the trench backfill is required. Type C Trench Backfill may be designated for open and unimproved areas outside of the public right-of-way where special compaction of the backfill is not required.

2. Type A Trench Backfill. Materials used for backfill shall be carefully deposited in layers as specified above, wetted to within 3 percent of optimum moisture content, and compacted to at least 95 percent of maximum dry density, as determined by AASHTO T99 or, for material which does not exhibit a typical well-defined moisture-density curve, 70 percent relative density as determined by ASTM D4253 and D4254.

   Compaction by flooding will not be permitted. Wherever the trenches have not been property filled, or if settlement occurs, they shall be reopened to the depth required for proper compaction and refilled and recompacted.

   For graveled streets, the backfill shall be completed by blading the stripped gravel back over the trench.

3. Type B Trench Backfill. Materials used for backfill shall be carefully deposited in layers as specified above, wetted to within 3 percent of optimum moisture content, and compacted to at least 90 percent of maximum dry density, as determined by AASHTO T-99 or, for material which does not exhibit a typical well-defined moisture-density curve, 50 percent relative density as determined by ASTM D4253 or D4254.

   In cultivated areas, the stripped topsoil shall be placed uniformly over the backfilled trench to the original depth. The top soil shall not be compacted but shall be graded to provide a smooth surface conforming to the adjoining ground surfaces. Any settlement of the trench surface below final surface

grade shall be remedied by the Contractor throughout the warranty period at no additional cost.

Compaction by flooding will not be permitted. Wherever the trenches have not been properly filled, or if settlement below final grade occurs, they shall be reopened to the depth required for proper compaction, refilled and recompacted.

4. Type C Trench Backfill. Materials used for Type C Trench Backfill shall not require special compaction. However, the material shall be placed in layers to achieve a density approximately equal to the density of the existing soil.

   The Contractor may be required to mound excess earth over the top of the trench so that a depression will not be formed after the trench settles. Placement of material in cultivated areas shall conform to the requirements of Type B Trench Backfill.

5. Replacement of Unsuitable Backfill Materials. Wherever, in excavating the trench, the native trench material consists of peat, soft clay, quicksand, or other material which, in the opinion of the Engineer, is unsuitable for use as backfill material or which cannot be readily conditioned or dried to be made suitable, such material shall be removed and disposed of by the Contractor. The material thus removed shall be replaced with suitable surplus material obtained from trench excavation materials from other areas within the limits of the project at no additional cost. If surplus material is not available within the limits of the project, the Contractor shall furnish suitable material from an approved borrow source which shall be paid as Imported Backfill Material. All such material shall be placed and compacted in accordance with the requirements of the classification of backfill specified for the trench section.

D. Backfilling For Appurtenances. Backfill around appurtenances shall be deposited in such a manner as not to disturb the appurtenance from its proper alignment, and then compacted to the finished grade. Backfill material, compaction and backfill procedures shall conform to the requirements of the related Type A or Type B Trench Backfill as specified herein for trenches.

E. Testing. Field density tests of the compacted fill will be performed at all levels. Testing will be performed as outlined within 2220, 3.14A. With the test frequency being 30 meter (100-foot) intervals of each lift, or as directed by the Contracting Officer's Representative.

The Contractor may be required at the direction of the Contracting Officer's Representative, to provide the necessary equipment and labor to excavate test holes into the compacted backfill to allow testing below the surface of the layers.

F. Special Compaction Requirements. The Contractor is cautioned regarding the need for careful attention to compaction in areas around existing facilities and obstructions and in areas where larger, trench-type compaction equipment is not suitable for use. Such areas include, but are not limited to, service line trenches, manholes, valve boxes, existing utilities and drainage and miscellaneous structures and pipes.

1.5 TRENCH MAINTENANCE

The warranty period and conditions for work under this section shall be as specified in the General and Supplementary Conditions.

1.6 CONTRACTOR'S SAFETY RESPONSIBILITIES

Whether utilizing Type 1 or Type 2 Trench Excavation, the Contractor shall be responsible for enforcing safety and maintaining safe working conditions in all trenching, shoring, and blasting operations to conform to OSHA regulations and any applicable local requirements.

The Contractor shall employ qualified, properly trained personnel to design shoring, perform safety inspections of the trenches, and supervise the handling of explosives, and other operations involving safety procedures, as prescribed by OSHA.

1.7 PROTECTION OF EXISTING PROPERTIES

A. General. Prior to beginning construction, the Contractor must contact all utility companies and/or public utilities having underground installations: sewer, telephone, water, fuel, gas, electric, etc., that may be encountered during the excavation. The Contractor must locate any underground installations and shall preserve intact any underground pipes or other utilities encountered during construction (except as hereinafter permitted) provided their location is such that they do not interfere with new pipelines or structures being installed. In case such utilities or other structures are accidentally broken, they shall be immediately replaced in a condition conforming to the standard repair practice of the utility.

Existing water services from the mains to private property which interfere with trenching operations shall be cut and replaced only with permission of the Contracting Officer's Representative, and if allowed, shall be done at the Contractor's expense. The use of such water service shall in no case be

interrupted for more than 4 hours, unless specifically permitted in writing by the Contracting Officer's Representative.

Existing water mains and water services shall be protected from freezing at all times during construction operations.

B. Maintenance of Flows. Adequate provisions shall be made or maintenance of flow of sewers, drains and water courses encountered during construction. Culverts, ditches, fences, crosswalks and structures which are disturbed by this construction shall be satisfactorily restored to their original condition upon completion of the work.

C. Structures. The Contractor shall exercise every precaution to prevent damage to existing buildings or structures in the vicinity of his work. In the event of such damages, he shall repair them to the satisfaction of the Contracting Officer's Representative.

D. Overhead Utilities. The Contractor shall use extreme caution to avoid a conflict, contact or damage to overhead utilities, such as power lines, street lights, telephone lines, television lines, poles or other appurtenances during the course of construction of this project.

E. Pavement Removal. Where trench excavation or structure excavation requires the removal of curb and gutter, concrete sidewalks, or asphaltic or concrete pavement, the pavement or concrete shall be cut in a straight line parallel to the edge of the excavation by use of the spadebitted air hammer, concrete saw or similar approved equipment to obtain a straight, square clean break. Pavement cuts shall be 600mm (2 feet) wider than the actual trench opening. If edges are broken during construction, the edges shall be recut prior to concreting or paving operations.

F. Survey Markers and Monuments. The Contractor shall use every care and precaution to protect and not disturb any survey marker or monuments, such as those that might be located at lot or block corners, property pins, intersection of street monuments or addition lines demarcation. Such protection shall include marking with flagged high lath and close supervision. No monuments shall be disturbed without prior approval of the Contracting Officer's Representative.

1.8 CLEANUP

As work progresses, that portion of the work completed shall be cleared of debris and brought to the finished grade. Upon completion of the work, the entire site shall be cleared of all debris and ground surfaces shall be furnished to smooth, uniform slopes and shall

present a neat and workmanlike appearance. All rocks brought to the ground surface by excavation or backfilling operations shall be removed.

1.9 TIME OF OPEN TRENCHES

The Contractor will be required to conduct his work so that trenches will remain open a minimum possible time.

No trench excavating shall begin until approved compaction equipment is at the site where the excavating is to take place. The maximum distance between backfilling and compaction operations and the end of newly installed pipe shall be 60 meters (200 feet) in existing streets and 150 meters (500 feet) in all other areas, and the maximum distance between the newly installed pipe and the excavator shall be 30 meters (100 feet) in existing streets and 60 meters (200 feet) in all other areas. For each work group consisting of a trench excavator, a pipe laying crew, and a backfilling and compacting crew, the maximum allowable open ditch at any time will be 90 meters (300 feet) in existing streets and 215 meters (700 feet) in all other areas. The maximum distance behind the end of the new pipe shall be 460 meters (1,500 feet) for gravel replacement, base placement or pavement replacement.

END OF SECTION 02221